Embedded Systems for Mechatronics – MF2103

Course Memo

Martin Edin Grimheden, mjg@kth.se

Course Admin

- Practical details
- Course design
- Examination & grading

… Followed by an introduction to Embedded Systems (30 min)
… Followed by an introduction to 1st part of course (30 min)
… Followed by a lab

Course Admin

- Practical details
- Course design
- Examination & grading

… Followed by an introduction to Embedded Systems (45 min)
… Followed by an introduction to 1st part of course (30 min)
… Followed by a lab

Teaching Team

- Teaching Assistants (the guys who really know)
  - Andrii Berezovskyi
  - Nils Jörgensen
  - Kaige Tan

- Lecturers
  - Lei Feng
  - De-Jiu Chen

- Course coordinator, Examiner
  - Martin Edin Grimheden

Course Platform

https://canvas.kth.se/courses/37967

- Course Administration
- Course Literature, Lecture Notes, Labs, etc.
- Announcements
- Personal messaging
- …
- Schedule
  - Link to https://www.kth.se/social/course/MF2103/calendar

Make sure you are registered!
  - Mailing lists & access is based on course registration

Schedule

https://www.kth.se/social/course/MF2103/calendar

- Lectures & Seminars
  - Location: See schedule (M33, Q31)
  - See schedule for agenda of each session
    - Notes:
      - Project introduction - Friday 20th Jan
      - Seminar 6 Introduction - Wednesday 15th Feb
    - Only physical meetings, no zoom

- Lab
  - Location: Wenström Lab, Brinellvägen 83, 3rd floor
    - Individual help – via Stay A While
    - Only physical meetings, no zoom

Online Meeting Details

https://canvas.kth.se/courses/37967/pages/online-meeting-details?module_item_id=557185

Lab sessions - How to get Help?

https://queue.csc.kth.se/Queue/MF2103

1. Tell us where you are
   (if not in the same lab)
2. specify what you need help with
3. We come to you

Course Admin

- Practical details
- Course design
- Examination & grading

… Followed by an introduction to Embedded Systems (45 min)
… Followed by an introduction to 1st part of course (30 min)
… Followed by a lab

Course Syllabus – Intended learning outcomes …

After passing the course, the students should be able to:

1. Give example of embedded systems and their applications and describe the special requirements that are set to develop such systems.

2. Be able to use modern integrated development environments for micro-controller/processor programming and their functionality for testing and troubleshooting.

3. Explain the structure of control circuits and built-in processors

4. Develop micro-controller programs for mechatronic applications including the use of I/O and external units.

5. Apply knowledge in programming, and to a lesser extent in digital technology and automatic control, in the design and realization of control software on distributed embedded systems.

6. Describe, explain and use software platforms, specific real-time operating systems (RTOS) and network protocols

Course Prerequisites

- Programming
  - C-programming, structures, pointers, etc

- Electrical engineering
  - circuit design, pull/push registers, transistors, etc.

Example of expected previous knowledge

- `AVR32_GPIO.port[1].gpers = 1 <<27;`

- `int i=(AVR32_GPIO.port[2].pvr >> 24) & 0x01;`

- `pFlt2_5++;`

- `CAN2515ByteWrite(Channel, RXF3SIDH, *pFlt2_5 >> 3);`

- `CAN2515ByteWrite(Channel, RXF2SIDL, (*pFlt2_5 << 5) |0x08 );`

Overall Course Structure

- 3 Modules

Week	Module	Teacher
W 3-5	Fundamentals of Embedded Computing Systems	Martin Edin Grimheden
W 6-7	Real-time Operating Systems	Lei Feng
W 8	Distributed Embedded Systems	De-Jiu Chen
W 9	*"Individual work"*	*You*

- Final written exam

Module Structure

- Each of the 3 modules consists of:
  - Seminars
  - Lectures (minimal)
  - Tutorials
  - Project

- Scheduled hours / week
  - One-two 2x45 min Lectures/Seminars
  - Three 2x45 min Lab sessions

- Expected additional individual effort
  - ~ 17hrs per week
  - homework, readings, lab work, etc.

- In total: 240 hours, 27h/w

A note of caution

- 17 hours per week of independent studies

- It's easy to get stuck with the labs, programming/debugging for 17+ hours/week, or more

- It's not so easy to prioritize reading the literature, in particular after X hours debugging.

- Try to find a good balance.

Seminars

- To learn
  - By reading the literature
  - Participating in group discussions, reflections and exercises.

- 6 Seminars (and 6 associated Assignments)
  - Document https://canvas.kth.se/courses/37967/assignments/222502
  - Assignments https://canvas.kth.se/courses/37967/assignments

Seminar Preparation
- Join the Seminar Introductions during scheduled sessions OR Listen to Seminar Introduction recordings from 2022
  - https://canvas.kth.se/courses/37967/pages/lecture-recordings
- Read the literature
- Assignment
  - Prepare any questions or topics you want to discuss
  - Submit a short assignment **before** each seminar.
  - To make sure you are all well prepared.

During the Seminar
- You
  - Discuss in small groups
  - Raise any questions or reflections you want to discuss with the rest of the classroom

- We
  - Support you with outstanding questions and issues

A note of caution

- Lectures
- Lab sessions
- Seminars
- Seminar-intros
- Assignments
- Tutorial
- Project
- Project-intro

A note of caution

- Lectures   (I lecture)
- Lab sessions   (You get support in the lab)
- Seminars   (We discuss your assignments)
- Seminar-intros   (I try to explain some things before the seminars)
- Assignments   (You read and prepare the seminars)
- Tutorial   (Instructions and lab exercises, you do)
- Project   (You do a project)
- Project-intro   (We explain the project)

Another note of caution

- In 2022, the course was given in zoom. All lectures were recorded.
- All recorded material is available on Canvas.
- Use freely – with caution.

Tutorials

- 5 Tutorials

- Step-by-step walkthrough instructions to help you learn.
- supervision and help from teaching team.
- Work in teams
- Needs <u>not</u> be reported

- Lab sessions - Dedicated sessions for each module's tutorials
  - Use to get help from the teaching team
  - Use for the designated module
  - <u>Not</u> to catch up on old work

- **Note**: Additional non-scheduled effort is expected to finalize tutorials.

The Project

- 1 Project → 3 Parts
  - Document https://canvas.kth.se/courses/37967/pages/mf2103-programming-project
  - Assignments https://canvas.kth.se/courses/37967/assignments

- An open-ended task to prove (to us and yourself) that you have learnt
- supervision and help from teaching team
- work in pairs

- <u>To be reported</u>

- Lab sessions
  - Use to get help from the teaching team

- Additional non-scheduled effort is expected to finalize the project.

Hardware

https://canvas.kth.se/courses/37967/pages/hardware-platform

- You work in groups of two

Course Literature

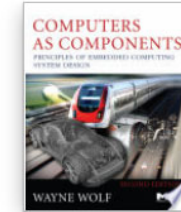https://canvas.kth.se/courses/37967/pages/course-literature-and-manuals

- Course material clearly indicate which sections are relevant for this course.
  - Note the reference code (ex. **[Wolf-CasC]**)

- All material is available digitally

- Use the versions we provide links to
  - For easier communication with teachers

Course Literature
- Tips

- O'Reilly Media or Knovel?
  - Knovel – Can download PDFs to read offline
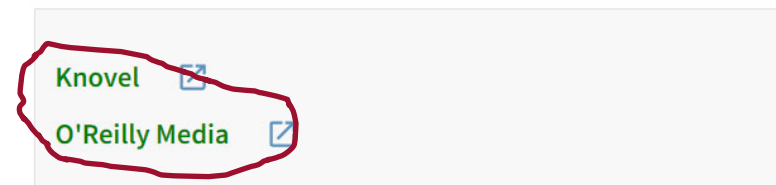 - O'Reilly Media – Only available online

- To gain access via O'Reilly Media
  1. Select O'Reilly Media
  2. Select "Not listed? Cick here" when prompted for an institution.
  3. enter your kth-email address

- [STM-STLink]
  - Pdf has comments of relevant for this course.

- **[STM-STLink]** STMicroelectronics, Using ST-LinkV2 and MDK 5 with DiscoveryNucleo Boards
  - Download file (With Comments for MF2103) Using ST-LinkV2 and MDK 5 with DiscoveryNucleo Boards.pdf
  - https://www.keil.com/appnotes/docs/apnt_286.asp

BOK
**Computers as components : princ
design**
Marilyn Wolf 1958- author.
2008 2nd ed..

≡ Kapitel i denna bok (39) ›

Online

Knovel
O'Reilly Media

Course Admin

- Practical details
- Course design
- Examination & grading

… Followed by an introduction to Embedded Systems (45 min)
… Followed by an introduction to 1st part of course (30 min)
… Followed by a lab

Examination Components & Grading

- Examination consists of:
  - LAB3 – Laboration
    - 5.0 credits
    - Grading scale: P, F
  - TEN2 – Examination
    - 4.0 credits
    - Grading scale: A, B, C, D, E, FX, F

The final grade of the course is equivalent to the grade of TEN2
→ But work on LAB3 can result in bonus points towards TEN2

Examination Components & Grading - LAB3

- A pass (P) grade is awarded for successful completion of each of the following:

  1. 6 Reading Assignments for Seminars 1-6
  2. The Project (in 3 parts)
  3. Return complete and functional lab equipment

  - For assignment details and deadlines
    - See https://canvas.kth.se/courses/37967/assignments

Examination Components & Grading - LAB3

How to get the project approved?

- Successful reporting of each part of the Project.
- Each part consists of:
  1. An oral presentation of your results to one of the teachers or lab assistants.
  2. A submission of successfully running program

- You can work in groups of <u>two</u> people

Examination Components & Grading - LAB3

- Project deadline?
  - The deadline for the reporting of all project parts is **Friday 3rd March 2023 12:00**.

- If you miss the labs deadline?
  - After this deadline, If not all parts are approved, then the LAB3 component may not be reported - until the next time the course is given.
  - After this deadline, a student can no longer expect any support from the teaching team, nor access lab equipment - until the next time the course is given.

Examination Components & Grading - Bonus Points

4 opportunities to gain bonus points towards final grade
- Total: 16% towards your final grade

1. For each project part: **Submit** a successful program at an earlier deadline.
   - **Presentation** can be done at a later time, no later than the last lab session.
   - Need to pass both code and presentation to get bonus points.
   - 4 points for each deadline

Project part	Deadline for Bonus
Task1 - Digital I/O and control	Monday 6th Feb. 2023 23:59
Task2 - Real-time operating systems	Tuesday 21st Feb. 2023 23:59
Task3 - Distributed systems using TCP/IP	Friday 3rd March 2023 09:59

2. Perform an extra task for the 3rd project part.
   - See project assignment document for details
   - Deadline: Same as Deadlines above
     - Tips: Aim for either Deadline-only bonus (4), or Extra-on-Deadline bonus (8)
   - 4 points for each extra task
     - In practice: you cannot only get 4 points, since you also need to gain the Deadline bonus (4)

Examination Components & Grading
- Bonus Points

- Bonus points are used as an alternative to answering specific question(s) in the final written examination.
  - you receive full points on <u>selected (by us)</u> question(s)
  - As a percentage, the question(s) weight the same as the bonus points.

- Advantages?
  - More time for less questions in the final exam
  - Already guaranteed a certain % (An extra grade?)

- Only valid for the ordinary exam & re-exam in 2023
  - Not for future exams
  - Not for "top-up" exams

Examination Components & Grading - TEN2

- 4 hours, written exam

- No books nor papers, only a pen

- What is covered by the Final exam?
  - The mandatory course literature
    - https://canvas.kth.se/courses/37967/pages/course-literature-and-manuals
  - The Lecture Notes
  - Tutorials, Project

Examination
- Code of Conduct

- This course applies the following codes-of-conduct
  - https://www.kth.se/en/eecs/utbildning/hederskodex/inledning-1.17237
  - https://www.kth.se/en/student/stodkontakt/stod/fusk-1.997287

→ Read it and the associated 6 rules!

Admin Questions?

… Followed by an introduction to Embedded Systems (30 min)
… Followed by an introduction to 1st part of course (30 min)
… Followed by a lab